



Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at <http://about.jstor.org/participate-jstor/individuals/early-journal-content>.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

THE LOUP FORK MIOCENE OF WESTERN KANSAS.

By CHARLES H. STERNBERG, *Lawrence.*

IT may seem like telling an old story to speak in this Academy of the Upper Miocene formation. However, as the writer made the first large collection of vertebrate fossils in it, and has spent five seasons there, including the one just past, he hopes to give some information of value in connection therewith.

For countless ages animals have lived out their allotted span, have fought the ever-recurring fight for food and life, and they were finally stricken down by their fellow creatures or by the pitiless forces of nature. The same blind forces covered the remains in the ooze of old ocean, the silt of the lake, or backwater from an ancient stream overflowing its flood-plain, covering the bones with loads of sand or mud. In the course of centuries the burial-places are lifted high and dry, and by the denudation of land in excavating some river valley or during the recession of cliffs their bones are exposed. Under the patient skill of the collector they are secured from their resting-places. In the past fifty years many noble skeletons of the animals have been gathered into museums. Men of wealth are collecting the faunæ of many geological horizons, so that it is now possible to get a good idea of the ancient history of animal life on our earth.

It should humble us "lords of creation." Like the older Agassiz, we should uncover our heads when we enter a paleontological museum, for we stand in the presence of the wonderful works of the creator—works which until only recently has man looked upon with intelligent eyes. In July, 1877, the writer was ordered north from Buffalo Park by Prof. E. D. Cope, in search of fossil vertebrates in the valley of the Loup Fork of Nebraska. An old-line hunter, Abernathy by name, chanced to be at Buffalo selling his last lot of buffalo hides. He spoke of a skull of an elephant in a ledge of sandstone above his cabin. Following this information, the writer, with his assistants, Russell T. Hill and Wilbur Brouse, was delighted to find the first Loup Fork vertebrate he ever collected. It was a great land turtle. These rocks are too old for the elephant; the top of the carapace was so exposed as to seem to an ordinary observer like the back of the head of a large beast. This find was on the middle fork of Sappa creek, some fifteen miles above Oberlin, which place then consisted of a store building in which a

general stock of everything needed by the first pioneers of that part of the state were sold. Parts of Decatur and Rawlins counties were explored, and here were discovered the rhinoceros, three-toed horse, and other animals of the Upper Miocene. One thing frequently noted here was the conglomerate of gravel or fine sand bound lightly together with the chalk that had been washed into whiting by the streams that flowed over the Niobrara group of the Cretaceous rocks that lie immediately underneath. Where masses of this material have disintegrated at the foot of some cliff, the resemblance to old, weather-beaten mortar is so great as to attract instant attention. It is pleasant to know that the geologists of Kansas now call these "mortar beds." The resemblance in many instances was real, as the early settlers plastered the inside walls of their sod houses by simply mixing water with it, and laying it on with an ordinary trowel.

The great land turtle discovered on the Sappa was named *Testudo (Xerobates) orthopygia* by Cope. Here was also found the short-limbed rhinoceros, called at that time *Aphelops fossiger* Cope, the generic name meaning without horns, as they were absent in the female skull Cope described. As the late Dr. J. B. Hatcher found them on the male, he changed the generic name to *Teleoceras*. In 1882, while in the employ of the museum of comparative zoology of Harvard, the writer discovered the famous locality at Long Island, Phillips county. In 1884 he was employed to explore this deposit for Professor Marsh, of the United States Geological Survey, and, with the assistance of J. B. Hatcher, who was at that time an enthusiastic student from Yale, and who made the first collection of his life there, they collected about ten tons of the bones of rhinoceros, representing many individuals. Professor Marsh leased this quarry, and at once it took the name of the Marsh quarry. A narrow ravine cuts through the center of the deposit. The bones lie scattered along either side of the ravine for a quarter of a mile, often in pockets, or pot holes, in the hard sandstone layer. There are two of these layers, about fourteen feet apart. The interspace is filled with beds of fine molding sand, with some whiting, formed by the wash of the underlying chalk, which when these beds were laid down formed the land surface. There are also beds of sand that have been washed clean by some old current in the floodplain of an ancient river, for the exposed section shows all the different deposits of a river valley. Above the washed sand is a stratum of sand and clay, showing that the muddy backwater had deposited in a quiet place its load. This layer, on exposure, cracks

in all directions, like the mud in the bottom of a puddle after the water has evaporated.

It has always been a problem to account for the great number of animals represented, and the fact that the bones are all scattered. No two bones are in their natural position; all parts of the skeleton are mingled in the greatest confusion. One would of course be forced from his observation of this region to agree with Doctors Matthew and Hatcher as to the fact of the deposition of these bones in the flood-plain of a running stream of water and not in great lakes, as was believed by the older geologists. The only way the writer has been able to account for the intermingling of all the bones of the skeletons on the bottom sandstone layer is, that as this sand when thoroughly saturated with water would become quicksand, the bones, scattered through the fourteen feet above where they now lie, would sink in it until the impenetrable bottom layer was reached. When the land had not been cut by drainage channels one can readily believe that the above idea would account for the mingling together indiscriminately of the bones of the many skeletons. What caused the death of such vast numbers of rhinoceroses in this place is a question not easily answered. The authorities quoted believe that during great floods all the animals in the vicinity sought the highest point they could find to escape death, but at last their efforts were in vain, and they were drowned in the flood that covered every inch of land. After maceration took place the bones might have been scattered by other floods. Another and equally plausible theory of the writer is that the animals were buried beneath a great sand-storm that tore loose the fine sand of the flood-plain and scattered it in suffocating volume over the frightened multitude, which had sought safety or courage by herding together. One can readily agree with the gentlemen referred to, that, during the Upper Miocene time, there were many watercourses separated by slightly elevated divides and broad flood-plains. Possibly here and there were small lakes where the dense vegetation had clogged some sluggish stream. During a rainy season the whole region for many miles might be converted into lakes and the animals driven from their haunts, and, worn out in efforts to escape, would at last succumb to the inevitable. Another thought in this connection is, that the land was not then elevated above the sea-level more than a few hundred feet. Now it is 3000 feet. This would account for the tropical climate, the slow, sluggish streams, bordered everywhere with swamps, filled with rushes

and sponge moss, while in the more solid ground trees and shrubs, like those of the tropics, raised their heads to the sun.

Last season the writer discovered the most complete set of lower jaws of the great inferior tusked mastodon, at the Sternberg quarry. The jaws miss part of the end that are united at the symphysis and prolonged forward into a broad rostrum, into which the inferior tusks are inserted. These tusks are absent in this specimen, though very complete ones have been found that have fallen out of their sockets, and show that they projected eighteen inches from the jaw, the roots reaching back about two feet to the last molar, that in this set had full possession; the other molars had been cast out. The length of the preserved jaws was two feet six and a half inches. Height at condyles, fourteen inches. In the center of the grinding surface of the last molar the height is nine and a half inches. The length of the molar is about seven and a half inches, and three and a half inches wide. The great distinguishing character of this first mastodon lay in the fact that only a narrow strip of enamel covered the inside of the tusk, while in all the descendants the tusks are encircled with enamel.

The dominate life in northwestern Kansas at that time was the rhinoceros, *Teleoceras fossiger*, and the great land turtle, *Testudo* (*Xerobates*) *orthopygia* Cope. As early as 1882 a large collection of these turtles was made in a narrow gulch that had been carved out of the sand by water on Beaver creek, near the old site of a town of that name.

A great deal of labor was required to secure specimens from the Loup Fork sands. The turtle shells were scattered through sand about four feet in thickness along the face of the bluff for 100 feet; about six feet below was the bed-rock, on which were scattered rhinoceros and other bones. The fact that the limbs were present in many cases precludes the possibility of their sinking in quicksand after death, as, in that case, the loose bones of the endoskeleton would have been left behind; for the same reason they could not have been brought to burial by water very long after death.

During Pliocene time, a little later, the great elephant, *Elephas columbi*, ranged in great numbers over the same region. In 1894 the writer discovered a large deposit of these bones, which are preserved in the University of Kansas.